Title: OPTIMIZATION OF PRECIPITATION RETRIEVAL ALGORITHMS FROM PASSIVE MICROWAVE...
GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 07/09/96

Project No. E-21-594
Project Director GASIEWSKI A J
Center No. 10/11-6-P5126-0A0
School/Lab ECE
Sponsor NASA/HEADQUARTERS/WASHINGTON, DC
Contract/Grant No. NGT-50903
Contract Entity GTRC
Prime Contract No.

Title OPTIMIZATION OF PRECIPITATION RETRIEVAL ALGORITHMS FROM PASSIVE MICROWAVE

Effective Completion Date 951231 (Performance) 960229 (Reports)

Closeout Actions Required:

<table>
<thead>
<tr>
<th>Action</th>
<th>Y/N</th>
<th>Submitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Invoice or Copy of Final Invoice</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Final Report of Inventions and/or Subcontracts</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Government Property Inventory &amp; Related Certificate</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Classified Material Certificate</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Release and Assignment</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

Comments

Subproject Under Main Project No.

Continues Project No.

Distribution Required:

<table>
<thead>
<tr>
<th>Distribution Required</th>
<th>Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Director</td>
<td>Y</td>
</tr>
<tr>
<td>Administrative Network Representative</td>
<td>Y</td>
</tr>
<tr>
<td>GTRI Accounting/Grants and Contracts</td>
<td>Y</td>
</tr>
<tr>
<td>Procurement/Supply Services</td>
<td>Y</td>
</tr>
<tr>
<td>Research Property Management</td>
<td>Y</td>
</tr>
<tr>
<td>Research Security Services</td>
<td>N</td>
</tr>
<tr>
<td>Reports Coordinator (OCA)</td>
<td>Y</td>
</tr>
<tr>
<td>GTRC</td>
<td>Y</td>
</tr>
<tr>
<td>Project File</td>
<td>Y</td>
</tr>
<tr>
<td>Other</td>
<td>N</td>
</tr>
</tbody>
</table>

NOTE: Final Patent Questionnaire sent to PDPI.
Final Status Report
for
NASA Grant NGT-50903
Graduate Student Research Program Fellowship

Optimization of Precipitation Retrieval Algorithms
from Passive Microwave Measurements

Submitted by:
Professor Albin J. Gasiewski
School of Electrical and Computer Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0250
(404) 894-2934 (O) 04) 894-4641 (F)
tag14@prism.gatech.edu

May 24, 1996

NASA grant NGT-50903 provided support for the graduate work of Ms. Gail M. Skofronick-Jackson at the Georgia Institute of Technology from July 1, 1992 through September 30, 1995. During this time Ms. Skofronick-Jackson worked in the GT School of Electrical and Computer Engineering’s Laboratory for Radio Science and Remote Sensing (LaRRS) under the guidance of Professor Albin J. Gasiewski. The original goal of her work was to develop optimal precipitation parameter retrieval algorithms applicable to multichannel passive microwave imagery observed from space. Specifically, this was to be accomplished using computer simulations of the mapping and retrieval process, including the effects of spatial filtering, sensor noise, and geophysical scene variability. Optimal nonlinear retrieval algorithm development was identified as a major goal of this work.

Ms. Skofronick performed forward radiative transfer calculations to synthesize multispectral brightness temperature maps of a tropical squall from 3-dimensional microphysical storm cell data. Her simulation included several channels proposed for the NASA/ESA Multispectral Imaging and Mapping Radiometer (MIMR), specifically, 6.0, 10.7, 18.7, 22.3, 37.0, and 89.0 GHz. During this process Ms. Skofronick identified a commonly-made modeling error regarding the number of hydrometeor phases used in radiative transfer modeling. Her work showed corroborated the use of a five phase model in the description of the hydrometeor field.

Using the synthesized imagery, simulations of the satellite mapping and retrieval process were performed, including the effects of antenna pattern convolution, sampling, instrument noise, and optimal retrieval. A nonlinear statistical retrieval algorithm for rain rate (RR) and integrated ice content (IIC) using supervised nonlinear inversion was developed and tested. The use of Karhunen-Loeve prefiltering prior to retrieval algorithm development was tested. Error statistics using the nonlinear algorithm showed that the KL prefiltering serves to reduce error for retrievals were the geophysical quantity of interest dominates the brightness temperature signature (for example, in
retrieving IIC), but generally not in other cases. Further, the area-averaged error is a strong function of the spatial resolution, which is in turn dictated by the available aperture size of the microwave antenna. For a 1.6 meter diameter aperture (typical of a MIMR-class system), the area-averaged error standard deviation for RR increased by ~220% relative to full resolution imagery. Error standard deviation for IIC increased by only ~49% since IIC is primarily obtained from the high-frequency (and, hence, high resolution) channels.

Significant milestones passed by Ms. Skofronick-Jackson under the support of NASA grant NGT-50903 include:

Ph.D. qualifying examination, Georgia Institute of Technology School of ECE, passed March 1992.

Ms. Skofronick-Jackson is completing a draft of her dissertation, of which approximately half has been written. This work is being carried out off-campus, with completion expected in late 1996.

During her residency at Georgia Tech, Ms. Skofronick-Jackson performed the task of LaRRS computer systems manager, administering a system of five computer workstations serving over two-dozen students. Her performance as system manager was exemplary. Upon leaving Georgia Tech in September 1996, she has continued her collaboration with LaRRS by making the synthetic brightness imagery and associated software available for LaRRS use in neural net retrieval studies.

Publications

A summary of publications stemming from NASA grant NGT-50903 follows:

Refereed Journal Publications:


Conference Publications (full paper, refereed):


